Műszaki Katonai Közlöny

XXVIII. évfolyam, 2018. 4. szám

Rácz Sándor[1]

FIREFIGHTING PROBLEMS IN CASE OF LARGE OUTDOOR FIRES

(NAGY ALAPTERÜLETŰ SZABADTÉRI TÜZEK OLTÁSÁNAK PROBLÉMÁJA)

Humanity has been using the fire since ancient times, so people have come to know the favourable and dangerous factors of fire. Outdoor fires are one of the most typical natural disasters in the world. In some cases, outdoor fires can endanger human life and material goods and it means a major challenge of the disaster management. As a result of global climate change, extremely dry weather factors provide more options for the vegetation to ignite. When writing the paper, it was important to analyse and study the relevant literatures of the topic, and the related data collection. In addition, it is important to mention the personal consultations with various experts, and the personal experiences of the author on the subject. As a result of the paper, the problems of large outdoor fires can be determined, in particular with the logistic and organizational difficulties. In addition, the author suggests reducing the logistical difficulties for more effective firefighting. The effective firefighting results significant savings to the national economy.

Keywords: *outdoor fire, vegetation, statistic, logistic difficulties, organizational difficulties*

Az emberiség már ősidők óta használja a tüzet, ez idő alatt pedig megismerkedett annak kedvező és veszélyes tényezőivel is. A szabadtéri tüzek manapság az egyik legjellemzőbb természeti katasztrófák, amelyek bizonyos esetekben az emberi életet és az anyagi javakat is veszélyeztethetik. Éppen ezért, a nagy alapterületű tüzek megelőzésére és a hatékonyabb tűzoltás megvalósítására a katasztrófavédelemnek valamilyen megoldást kell találnia. A problémát tovább nehezíti, hogy a globális éghajlatváltozás eredményeként a rendkívül száraz és csapadékmentes időszakok több lehetőséget kínálnak a biomassza meggyulladására. A cikk megírásában fontos szerepet játszott a hazai és nemzetközi szakirodalom tanulmányozása és elemzése, valamint a különböző szakértőkkel folytatott személyes konzultációk valamint a szerző személyes tapasztalatai a témával kapcsolatban. A cikk eredményeként meghatározhatók a nagy alapterületű szabadtéri tüzek oltásának problémái, különös tekintettel a logisztikai és a szervezési nehézségekre. Ezen felül a szerző javasolja a tűzoltást akadályozó logisztikai nehézségek csökkentését a hatékony tűzoltás tekintetében, amely jelentős megtakarítást eredményezhet a nemzetgazdaság számára.

Kulcsszavak*: szabadtéri tűz, vegetáció, statisztika, logisztikai nehézségek, szervezési nehézségek*

INTRODUCTION

Global climate change is a constant argument in all fields of science. However, it is accepted today as a fact in all scientific fields. Climate change affects not only Hungary, Europe and every single country on the world. When we analyse the Earth's climate, it can be stated that the climate has constantly changed in the history of our planet. Glacial and interglacial periods followed each other, but earlier this was not in the focus of attention. [1] In the media, it can be

[1] Egyetemi tanársegéd, Nemzeti Közszolgálati Egyetem, Katasztrófavédelmi Intézet, Budapest. e-mail: racz.sandor@uni-nke.hu , ORCID: 0000-0001-9955-924X

seen that the fight against fire is not only in Hungary, but in other countries of the world. It is a real threat, which is waiting to be solved. [2] Each year thousands of forest and vegetation fires occur in Hungary. In recent years, the number of outdoor fires was more than nine thousand on average. [3] The two extremely dry years (2011 and 2012) significantly exceeded this value. [4] In Hungary, on one hand, climatic conditions, on the other hand, due to the vegetation composition, the natural and vegetation fires are negligible. (Only 1%) Most of the outdoor fires can be traced back to human negligence or intent.

But in order to make conclusions of the outdoor fires, it is essential to analyse relevant statistic on forest and vegetation fires. In addition, it is important to investigate the effectiveness of firefighting and its influencing factors. In the following chapter of the paper, the author will show and analyse these factors.

STATISTIC ON OUTDOOR FIRES

Doing researches in connection with the outdoor fires it is essential to make an international outlook of the topic. Within it, the author examines the reports of the European Union's forest fire reports to the international organisation EFFIS[2]. In Hungary the Forestry Authority operates a National Forest Fire Database. This database contains the most important data in connection with the burnt down areas. Based on data, Hungary also provides data on burned forest areas in the European Forest Fire Information System (EFFIS). This data is provided outside of Hungary by some other EU member states, as well as by some countries in the Middle East and North Africa regions, resulting a global picture of the threat of the international forest fire.

The most recent international report on the EFFIS website is the report of the year 2016 by the member states of the European Union. Based on the report, it can be determined that a significant number of forest and vegetation fires were generated in and beyond Europe. However, by September of 2017, outdoor fires have destroyed nearly 700,000 hectares of forest areas in the EU, which has resulted in the most destructive fire season since the data collection has begun. In addition, the fire season of 2016 demanded human lives, mainly in southern Europe. These data were mainly due to long-term hot waves, droughts and strong winds, which gave options to ignite the vegetation. [5]

In assessing the damage caused by vegetation fire, it can be classified into the following three categories.

- Forest land
- Other wooded land
- Other land

Regarding all the fires, the area affected by outdoor fires in the examined period, averaged more than 4 hectares. However, fire damage is classified according to the size of all burned areas.

[2] European Forest Fire Information System. It has been established by the European Commission (EC) in collaboration with the national fire administrations to support the services in charge of the protection of forests against fires in the EU and neighbour countries, and also to provide the EC services and the European Parliament with harmonized information on forest fires in Europe.

Analysing the data in Table 1, it can be stated that the proportion of forest fires under one hectare exceeds 60%, and for vegetation fires this rate reaches 75% of all fires. In case of fires where the burnt area does not reach 1000 m^2, the proportion of fires involved is even more prominent (50% and 36%).

One indicator of the severity of a fire is the burnt down area during the fire. According to international statistics - fire classes can be divided into five categories. Small fire is the fire reaching less than one hectare. Medium-sized fires include fires from 1 to 50 hectares, and the large outdoor fires are more than 50 hectares. In case of medium and large fires, several fire forces may be alerted taking into account the risk factors (possibly the number of people to be flown, combustible biomass, weather, terrain, protected value).

Size of fire	**All outdoor fires**	
	Rate of the vegetation fires (%)	**Rate of the forest fires (%)**
less than 0,1 hectares	**50 %**	**34 %**
between 0,1 and 1 hectares	**25 %**	**27 %**
between 1 and 10 hectares	23 %	32 %
between 10 and 50 hectares	2,5 %	4 %
more than 50 hectares	0,5 %	1 %

Table 1- The proportion of outdoor fires in size groups generally from the last years. Made by: Peter Debreceni. Source: Forestry Directorate, National Food-Chain Safety Office.

It means that firefighters have to march with great forces to fires that could be prevented by fire regulations. It means high costs for the national economy. Overall, it can be stated that in Europe outdoor fires should get an importance. [6] Relate to the reports it can see how large areas of the forest fires can destroyed in a year, so the disaster management need to find some sort of solution to prevent this, especially not only in the field of the intervention but in the fire prevention as well. [7]

LOGISTIC DIFFICULTIES IN CASE OF LARGE OUTDOOR FIRES

One of the major problems during the firefighting is the extinguishing agent service. It is because of the lack of the hydrants in the forested area. In this case, only the natural and the man-made water sources are available for the firefighters. The water transport realized with the help of the special water carrier vehicles, but it is because of the dirt roads very time-consuming. These roads are, in most cases, very narrow and difficult to navigate on it. It can see some dirt roads on the Figure 1. These dirt roads greatly reduces the speed of fire engines. As the speed

decreases, firefighters will arrive later to the fire, so they will start the detection and the firefighting later as well. This has a significant influence on the efficiency of firefighting.

The problem with these roads is that their cross-section is too narrow, so it is not possible to run two fire engines next to each other. Another problem of narrow roads is the reversal of the vehicle. For all major outdoor fire, a significant damage is caused to the fire engines by the roadblocks. In connection with the roads, it is necessary to elaborate a well-developed forest decree, regulating the formation of the forest roads. According to some authors, the ideal width of the roads would be at least 6 metres. Additionally, branches leaving the road should be removed at certain intervals. It is important that even in an event of violation of law, the town should be fined, because otherwise the compliance will not be met. [8]

One of the characteristic of the outdoor fires is that it can easily and rapidly to spread. Especially when the biomass of the area is dry. Another important factor of the fire spread are the weather conditions. The strong and changeable wind can help to the fire spread, even in some cases, it may cause spot fires. There are some solutions in order to prevent the rapid fire spread at international level. They use so-called mixed forestation system to prevent large wildfires. [9] According to some authors, the method could be applied in Hungary as well, as it would contribute to the effectiveness of fire protection. [10]

Figure 1 - Narrow, dirt roads in the forest. (Pilisszentiván, 2017) Made by: László Bodnár

On the whole it can be stated that the dirt roads are one of the major logistic difficulties during an intervention. In order to prevent this problem some author suggest to use aerial firefighting to solve the problem. Based on some Hungarian literature, it can be stated that firefighting can be various. Firefighters can intervene from the air, from deep (in caves), in water or even in built environment. The author also represents the whole spectrum of the interventions of the firefighters. [11]

Other authors suggest aerial firefighting in case of outdoor fires that can not be avoided by conventional tools. In this case, it examines areas that can not be realized with conventional equipment, because of the huge cost of the firefighting. Various mountainous areas or very loose, sandy soils belong to this category. In Hungary, some parts of the Great Plain belong here. The fire here may extend as long as it does not interfere with a natural obstacle (for

example a river) or the change of weather does not prevent the fire spread. The economic criterion for the use is only that the value saved from the fire must be greater than the total cost of aerial firefighting. [12]

The conclusions drawn from the analysis have shown that the use of aerial firefighting is more expensive than conventional firefighting, but counting with the non-burnt areas, which can be saved, the aerial firefighting can named effective. It can save more money for the national economy. [13] But to recognize the need for aerial firefighting, quick and effective firefighting decision-making is needed from the leader of the firefighting. [14]

ORGANIZATIONAL DIFFICULTIES

Large outdoor fires have not only logistic but organizational challenges as well. These interventions require experience and serious expertise from the leader of the firefighting. The legislative background to the topic is the regulation on the general rules of the firefighting and of the technical rescue operations of the fire departments. [15] The intervening forces must pay attention to a lot of circumstances. For this reason, in Hungary, a Firefighting Order and a Technical Rescue Order are issued in order to help to the intervening forces. [16]

The intervention during an outdoor fire is a complex operation. Attention should be paid to some factors:

- The large-scale forest and vegetation fires require special tools and tactics.
- If the size, complexity or duration of the fire justifies it, leadership should be organized.
- The members of the leadership are experts.

The leader of the firefighting must create separate firefighting sections at a large forest fire. These sections are capable of performing individual and coordinated tasks for each firefighting within the territory. At the head of the sections there is a section commander. This commander keeps in touch with the other groups and sections. [16]

For example in Hungary was a large outdoor fire in 2007 in Kunfehértó. The affected area was more nearly 2000 hectares. So the leader of the firefighting decided to lead the intervention in two sections. In the first section were 25 different fire engines and water transporters with 100 people. In the second section were 6 fire engines with 21 people. Volunteer civilians were with a total of 70 people with several hand tools. [8]

In case of large outdoor fires similar to the Kunfehértó fire, where several fire forces and squads work at the same time, it is necessary to share the leadership of fire. The Figure 2 illustrates its method.

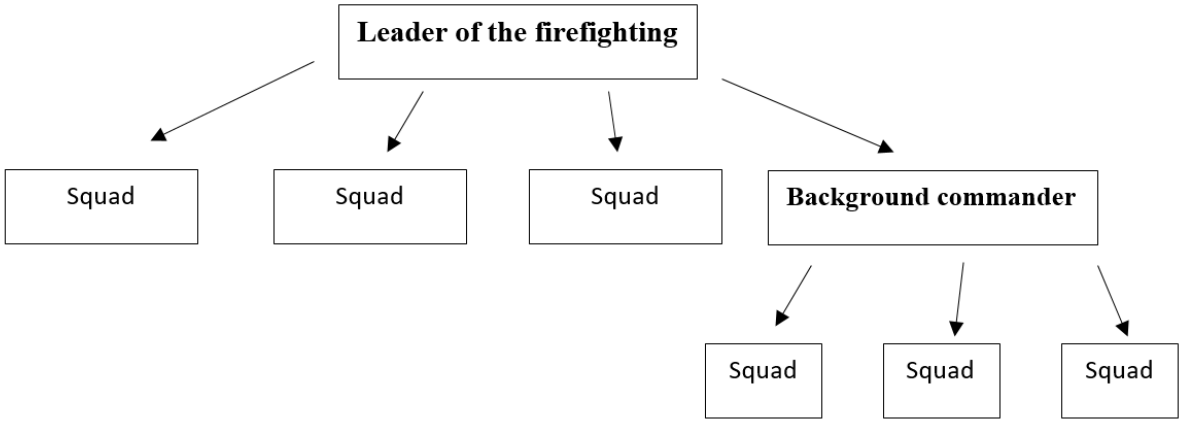

Figure 2 – Group Management leadership in case of an intervention. Source: [16]

In this case, firefighters can only be command with the help of sharing the leadership. This happened in Kunfehértó as well.

The shape of fire and the spread

In order to make an effective firefighting intervention, it is very important to follow the rules of power-tools and vaccine calculation. One of its influencing factors is the form and extent of fire spread. First, the size of the fire must be determined on the basis of the location and spread of fire. Then the typical dimensions should be compared with the radius of the fire. If the result of the comparison is that the radius of the suspected fire is smaller than any of the typical dimensions, the spread of the fire may be possible in all directions at the time of the test, that is, the shape of the fire spread in a circular direction. If the typical size of a possible propagation direction is smaller than that of the suspected fire then the fire spreading potential is limited in this direction, that is, in this possible spread direction the boundary of the fire area will be equal to the boundary of the typical size. [17]

In case of an outdoor fire the weather conditions have a major influence on the fire spread and on the fire shape. That is why an outdoor fire has a different fire spread than in buildings. At outdoor interventions the leader of the firefighting must pay attention to the spot fires, the fire flanks, the finger and head. Figure 3 illustrates these anatomical parts of a forest fire.

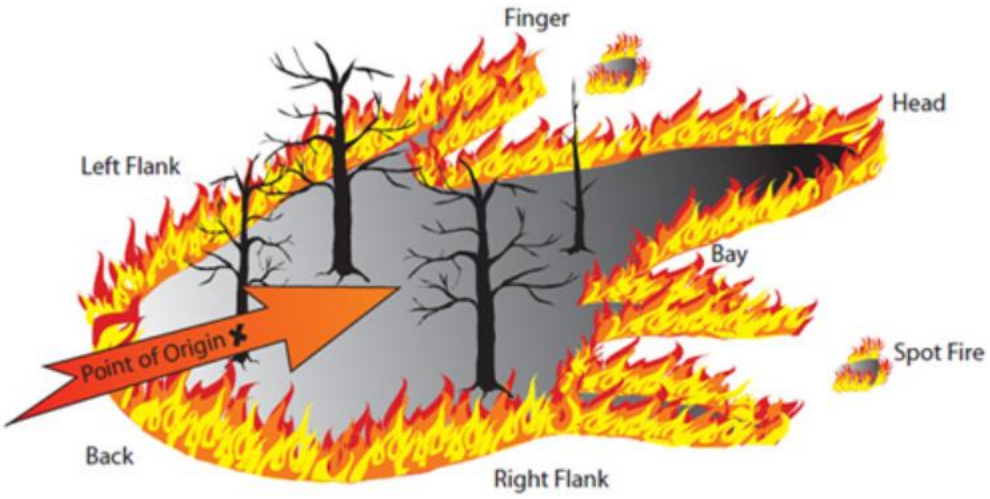

Figure 3- The anatomical parts of a forest fire. Source: [18]

Bay(s) — A marked indentation in the fire perimeter, usually located between two fingers.

Finger(s) — an elongated burned area(s) projecting from the main body of the f re resulting in an irregular f re perimeter.

Flanks — those portions of the fire perimeter that are between the head and the back of the fire which are roughly parallel to the main direction of spread.

Head — that portion of the fire perimeter having the greatest rate of spread and frontal fire intensity which is generally on the downwind and/or upslope part of the fire.

Back — that portion of the fire perimeter opposite the head; the slowest spreading part of the fire.

Island(s) — Area(s) of unburned fuels located within the fire perimeter.

Point(s) of Origin — the location(s) within the fire perimeter where ignition first occurred. [18]

The development of an outdoor fire takes from the generation to the start of firefighting.

Definition of it:

$$t_d = ta + tm + tp$$

$\mathbf{t}_d$ – the duration of free evolution of fire

$\mathbf{t}_a$ – time from the fire detection to the alarm;

$\mathbf{t}_m$ –time of marching;

$\mathbf{t}_p$ – time of preparation;

Effective firefighting is required for the entire or only part of the fire area where the firefighting is performed on the basis of tactical convenience or necessity. [17]

SUGGESTIONS FOR A MORE EFFECTIVE FIREFIGHTING

The problem of starting every firefighting activity is that it is difficult to see the size of the fire on the ground. Therefore, in the case of a large outdoor fire, the effective detection can only be achieved from the air, by means of aerial vehicles or drones. To do so, however, an aircraft is needed as soon as possible so that accurate reconnaissance can be realized as quickly as possible. [19]

In addition to the detection, there is another problem that the first arriving firefighters do not have an on-site map from the territory. In any case, the necessary maps will be selected and brought to the place of fire on the basis of detection of the first fire forces at a later time. It would be very effective if the first arriving fire departments already had a map that would contain the most important guides for firefighting management and organization. Current maps are in many cases inaccurate and the firefighting tactic information is usually not included in it.

In some cases outdoor fires can endanger private properties and farm buildings. For such estates often pine trees were planted a few meters from the forest. These pines are very flammable, so the farms have become more flammable. In case of a fire, the flames can easily spread to the estate, so it would be useful to determine the fire distance between the forests and the farms in law. (Ideal firing distance would be nearby 12 metres) As a result of this, the owners should not be afraid of the fire risk.

A constant problem of outdoor fires is the supply of water. In many cases, the required water should be sent to the fire from a long distance. It would also be a solution to provide man-made water sources at certain distances along the forests. Or another example for water source was at the vegetation fire in Kunfehértó, where a so called fire train helped in the water supply activity.

Another major solution can be to give a minimum work safety education to the civilian population who providing voluntary assistance at the intervention. So they will not harm themselves or anything else. They need to show them how to behave at an intervention and what kind of clothes they need to wear. [8]

SUMMARY

In the paper the author analysed the difficulties of firefighting of large outdoor fires in Hungary. This topic is getting more and more importance in the field of fire protection. As a result of the paper, the problems of large outdoor fires can be determined, in particular with the logistic and organizational difficulties. In addition, the author suggests reducing the logistical difficulties for more effective firefighting. The effective firefighting results significant savings to the national economy. As part of this, the author drew attention to the effectiveness of aerial firefighting in case of large outdoor fires.

Large fires can easily generate, when the weather conditions give reason for it. Fighting against the weather is impossible, so the intervening fire forces need to find tactical solution for the problem. One of the methods is to apply different prevention practices in the field of fire protection. But legislative changes and the re-education of the society can also be effective.

In catastrophes such as forest fires, the leader of the firefighting needs serious professional experiences in order to the effective firefighting. He needs to know the most efficient organizational and logistics solutions. This is only at the expense of serious professional experience. Therefore the firefighting trainings get a priority in the education as well. Its higher education is educated at the National University of Public Service at the Institute of the Disaster Management, which also proves the importance of the topic. [20]

REFERENCES

[1] Teknős László, Kóródi Gyula: A globális éghajlatváltozás biológiai kockázatának elemzése, hatásainak vizsgálata a katasztrófavédelemre I. Bolyai Szemle, XXV 1 (2016), 115-135.o ISSN: 1416-1443 https://www.uni-nke.hu/document/uni-nke-hu/bolyai-szemle-216-1.original.pdf

[2] Restás Ágoston: Az erdőtüzek légi felderítésének és oltásának kutatás-fejlesztése. Budapest, ZMNE. 2008. 132 o

[3] Debreceni Péter, Bodnár László - Pellérdi Rezső: Az erdőtüzek kockázatának csökkentési lehetőségei Magyarországon. Védelem Tudomány II 2 (2017), 1-11.o http://vedelemtudomany.hu/articles/01-debreceni-bodnar-pellerdi.pdf

[4] National Food - chain Safety Office: Information on the forest fire information system. Budapest, NÉBIH. Forestry Directorate. 2018.

[5] European Commission: Forest Fires in Europe, Middle East and North Africa 2016. Luxembourg, JRC Science Hub. 2017. ISBN:978-92-79-71292-0 http://effis.jrc.ec.europa.eu/media/cms_page_media/40/Forest_fires_in_Europe_Middle_east_and_North_Africa_2016_final_pdf_JZU7HeL.pdf (download 27.07.2018)

[6] Bodnár László, Pántya Péter: The threat of the forest and vegetation fires and the possibilities of the intervention in Hungary. AArms, Vol. 17 Issue 2

[7] Nagy Dániel: Az erdőtüzek megelőzési és oltástechnológiai lehetőségeinek vizsgálata; PhD értekezés, Nyugat-magyarországi Egyetem, Sopron, 2008.

[8] Gerner József: Összefoglaló a 2007. július 25–30 közötti időszakban bekövetkezett Kéleshalom–Kunfehértó, és a Kiskunhalas–Imrehegy közötti Kakas-hegyi V-ös kiemelt erdőtüzekről. (Szerzői kézirat)

[9] Ruhm Werner: Waldbauliche Grundlagen der Mischwaldbegründung. Österreichische

Forstzeitung; 106 2 (1996) p. 53-54

http://www.waldwissen.net/waldwirtschaft/waldbau/verjuengung/bfw_mischwald/inde

x_DE (download 09.04.2017.)

[10] Bodnár László, Komjáthy László: Erdőtűz megelőzési módszerek erdészeti megoldásai. Hadmérnök, XIII 2 (2018), p. 117-125

[11] Pántya Péter: Safety issues of firefighting interventions. In: Karol Balog, Jozef Martinka: Advances in fire and safety engineering 2014: recenzovaný zborník pôvodných

vedeckých prác z III. ročníka medzinárodnej vedeckej konferencie. Conference Trnava, Slovakia, 30.10.2014-31.10.2014. Trnava: AlumniPress, 2014. pp. 215-220. ISBN:978-80-8096-202-9

[12] Restás Ágoston: Theoretical approaches for evaluating the economic efficiency of the aerial firefighting helping strategic planning In: Domingos Xavier Viegas, Luis Marió Ribeiro: Advances in Forest Fire Research. Coimbra: Universidade de Coimbra, 2014. pp. 1900-1910. ISBN:978-989-26-0884-6

[13] Bodnár László: The efficiency of the aerial firefighting in Hungary using outside tank technology In: Branko Savić et al. Book of Proceedings: МЕЂУНАРОДНА НАУЧНА КОНФЕРЕНЦИЈА БЕЗБЕДНОСНИ ИНЖЕЊЕРИНГ. 530 p. Conference Novi Sad, Serbia, 05.10.2016-07.10.2016 Novi Sad: University of Novi Sad, Faculty of Technical Sciences, 2016. pp. 187-194.

[14] Restás Ágoston: Police, Soldier, Firefighter in Emergency: Decision Making Method is Special Security dimensions international and national studies 12 2 (2014), pp. 86-94.

[15] 39/2011. (XI. 15.) BM rendelet a tűzoltóság tűzoltási és műszaki mentési tevékenységének általános szabályairól. (39/2011 regulation of the Ministry of the Interior on the general rules for the fire and rescue operations of the firefighters)

[16] 6/2016. (VI. 24.) BM OKF utasítás a Tűzoltás-taktikai Szabályzat és a Műszaki Mentési Szabályzat kiadásáról. (6/2016. (VI.24.) NDGDM instruction on the issue of the Firefighting tactics and the Technical Rescue Rules)

[17] A BM Országos Katasztrófavédelmi Főigazgató 109 /2000. számú intézkedése a beavatkozáshoz szükséges erő-eszköz és oltóanyag számítás módjáról.

[18] Nova Scotia Canada: Media Guide to Forest Fires - Anatomy of a Forest Fire. https://novascotia.ca/natr/forestprotection/wildfire/media-guide/anatomy-fire.asp (download: 02.08.2018)

[19] Restás Ágoston: How Drones Can Support Fire Services. Prevention, Intervention, and Post Fire Monitoring. In: Branko Savić, et al. Book of Preceedings: МЕЂУНАРОДНА НАУЧНА КОНФЕРЕНЦИЈА БЕЗБЕДНОСНИ ИНЖЕЊЕРИНГ. 530 p. Conference: Novi Sad, Serbia, 05.10.2016.-07.10.2016. Novi Sad: University of Novi Sad, Faculty of Technical Sciences, 2016. pp. 293-301. ISBN:978-86-6211-106-7

[20] Restás Ágoston, Pántya Péter, Rácz Sándor, Érces Gergő, Hesz József, Bodnár László: A komplexitás értelmezése a Tűzvédelmi és Mentésirányítási Tanszék oktatási és kutatási tevékenységében. In: Vass Gyula, Restás Ágoston, Bodnár László: Tűzoltó Szakmai Nap 2018 Tudományos Konferencia. 233 p. Conference: Szentendre, Hungary, 18.04.2018 Budapest: BM Országos Katasztrófavédelmi Főigazgatóság, 2018. pp. 228-232. (ISBN:978-615-80429-6-3)